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EMBEDDING AN IDENTITY-MATCHING TASK WITHIN A PROMPTING HIERARCHY TO FACILITATE ACQUISITION OF CONDITIONAL DISCRIMINATIONS IN CHILDREN WITH AUTISM

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Least-to-most prompting hierarchies (e.g., progressing from verbal to modeled to physical prompts until the target response occurs) may be ineffective when the prompts do not cue the individual to attend to the relevant stimulus dimensions. In such cases, emission of the target response persistently requires one or more of the higher level prompts, a condition called *prompt dependence* (Clark & Green, 2004). Reinforcement of differential observing responses (DORs) has sometimes been used to ensure that participants attend to the relevant stimulus dimensions in matching-to-sample (MTS) tasks (e.g., Dube & McIlvane, 1999). For 2 participants with autism, we embedded an identity-matching task within a prompting hierarchy as a DOR to increase the likelihood that the participants attended to and discriminated the relevant features of the comparison stimuli in an MTS task. This procedure was compared with a traditional least-to-most prompting hierarchy and a no-reinforcement control condition in a multielement design. Results for both participants indicated that mastery-level acquisition of spoken-word-to-picture relations occurred only under the identity-matching condition. Findings are discussed relative to the use of DORs to facilitate acquisition of conditional discriminations in persons with autism or other conditions who do not attend to the comparison stimuli.

DESCRIPTORS: autism, differential observing response, identity matching, prompts, stimulus control, conditional discriminations

A common matching-to-sample (MTS) task used to teach conditional discriminations to children with and without disabilities is one in which the teacher or therapist dictates the sample stimulus (e.g., says "Alex") and the child is expected to manually select the correct answer from an array of cards depicting visual referents of the correct comparison stimulus (S+) and each incorrect comparison stimulus (S−) (e.g., randomly ordered pictures of Alex, Kim, Mark, and Stella). Teaching this and similar types of conditional discriminations to persons with autism or mental retardation can be quite challenging (McIlvane, Dube, Kledaras, Iennaco, & Stoddard, 1990; Perez-Gonzalez & Williams, 2002; Romski, Sevcik, & Pate, 1988; Saunders & Spradlin, 1989, 1990, 1993; Williams, Perez-Gonzalez, & Queiroz, 2005).

The most common method of training conditional discriminations has been referred to as "trial and error" (Saunders & Spradlin, 1990), and involves randomly presenting different sample stimuli (e.g., words like "Alex" or "Kim," or pseudowords like "nug" or "pled") on successive trials and correlating reinforcement with correct responding to the comparison stimuli (usually on a fixed-ratio 1 schedule). One alternative to the trial-and-error method is to present the same sample and comparison stimuli repeatedly in a block of successive trials

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(e.g., 32 successive trials in which "Alex" is the sample stimulus followed by 32 trials in which "Kim" is the sample stimulus). Block sizes are gradually reduced and finally sample stimuli are presented in random order. This method has been successful at teaching conditional discriminations to individuals with autism or mental retardation even when the trial-and-error method has failed (Perez-Gonzalez & Williams, 2002; Saunders & Spradlin, 1989, 1990, 1993; Williams et al., 2005). One limitation of this approach is its relative inefficiency (e.g., 2,688 trials to acquire the first conditional discrimination, 5,280 trials for acquisition of nine discriminations; Saunders & Spradlin, 1990).

Other procedures for increasing the likelihood that conditional discriminations will be acquired generally involve prompting and fading strategies aimed at minimizing errors and increasing the probability that the correct response will occur and contact reinforcement. For example, with prompt delay (or delayed cue or constant prompt delay), transfer of stimulus control is achieved by presenting a controlling prompt (e.g., physically guiding the correct response) concurrent with or shortly following the sample stimulus (e.g., "point to dog"). Over successive trials, a delay is inserted between the sample stimulus and the controlling prompt to fade the prompt (e.g., Charlop, Schreibman, & Thibodeau, 1985; Clark & Green, 2004; Halle, Marshall, & Spradlin, 1979). With another method, called least-to-most prompting, the task is presented in its terminal form at the start of a trial, and successive prompts within a trial provide increasingly more assistance to the individual (e.g., verbal instruction, followed by verbal instruction plus modeling, followed by verbal instruction plus physical guidance; Horner & Keilitz, 1975; Steege, Wacker, & McMahon, 1987).

Both prompt delay and least-to-most prompting have strong supporting literatures, and although prompt delay has sometimes been found to be more efficient than least-to-most prompting, both methods tend to be effective (Wolery, Ault, & Doyle, 1992; Wolery & Schuster, 1997). We have focused on least-to-most prompting in the current investigation because it is the prompting strategy most commonly used by special education teachers (Repp, Karsh, & Lenz, 1990), and it is arguably the most prone to result in prompt dependence.

Prompt dependence is said to occur when an individual's correct responding is persistently dependent on the controlling prompt (Clark & Green, 2004), and little or no progress is made in fading out the prompts (Brown & Miranda, 2006; Cheney & Stein, 1974; Etzel & LeBlanc, 1979; Guralnick, 1975; Koegel & Rincover, 1976; Oppenheimer, Saunders, & Spradlin, 1993; Wolfe & Cuvo, 1978). For example, with least-to-most prompting, the individual may learn to imitate the modeled prompt (e.g., simply pointing to the option the therapist pointed to rather than learning to point to the picture of Alex after the word "Alex" is spoken).

As an example of how this may occur, suppose that four comparison stimuli in an MTS task were placed face down rather than face up in front of the participant (and thus all of the stimuli would look the same; i.e., blank cards). Under this arrangement, the therapist could say, "point to Alex," and the participant would have a 25% chance of selecting the face-down picture of Alex following this sample stimulus. With least-to-most prompting, if the participant made an error (e.g., pointed to the face-down picture of Kim), the modeled prompt would be delivered (i.e., the experimenter would point to the face-down picture of Alex) and the participant could easily select the S+ even though the participant could not observe the visual features that distinguished the S+ (Alex) from each S− (Kim, Mark, and Stella). A prerequisite for displaying this pattern of responding would be that the participant had previously learned to imitate a model (Baer, Peterson, & Sherman, 1967). Although one

would not place the comparison stimuli face down in a real MTS teaching arrangement, the point of this example is to illustrate that it is possible that participants fail to learn spoken-word-to-picture discriminations even when the cards are face up if they have received reinforcement for imitating a model in the past and have become dependent on (or overgeneralized) such prompts.

One potential way to overcome this type of prompt dependence is to arrange prompts that ensure that the participant looks at and discriminates the distinguishing visual characteristics of the comparison stimuli (i.e., prompts that engender a differential observing response; DOR). By definition, observing responses result in sensory contact (usually visual) with stimuli that signal the availability of reinforcement without altering the availability of reinforcement (Wyckoff, 1952), and they are considered a necessary prerequisite for the establishment of stimulus control (Dinsmoor, 1985). In studies on multiple schedules, in which observational responses were first studied, these responses were reinforced by contingent access to discriminative stimuli (e.g., an observational response turned on a red light that signaled when extinction was in effect and a green light that signaled when a variable-interval 1-min schedule was operating). By contrast, in MTS studies, observing responses have generally been used to ensure that the participant looked at the sample stimulus prior to presentation of the comparison stimuli (Catania, 1992).

In most MTS studies, the same observing response (e.g., a pigeon pecking the response key depicting the sample stimulus) was used to ensure that the participant looked at each sample stimulus before it was turned off and the comparison stimuli were presented. Although this type of observing response guarantees that the participant looks at the sample stimulus, it does not ensure that the participant discriminates one sample stimulus from another. In other MTS studies, participants have been required to emit a unique response to each sample stimulus prior to presentation of the comparison stimuli; this unique response has been called a DOR (Constantine & Sidman, 1975; Dube & McIlvane, 1999; Geren, Stromer, & Mackay, 1997). A DOR helps to guarantee not only that the individual looks at the target stimulus but also that the participant discriminates the relevant aspects of the sample stimulus prior to selecting one of the comparison stimuli. For example, both Constantine and Sidman and Geren et al. improved accuracy on delayed-matching-to-sample (DMTS) tasks by instructing the participants to name the sample stimulus (as the DOR) prior to presentation of the comparison stimuli. Naming guaranteed that the participant discriminated the defining characteristics of each individual sample stimulus (hence the term *differential* observing response).

As an alternative to naming, Dube and McIlvane (1999) required participants to complete a nonverbal (or pictorial) simultaneous identity-matching task as a DOR; this ensured that the participants were attending to both components of a compound sample stimulus prior to completing the DMTS task. The procedure used by Dube and McIlvane is noteworthy in that it could be used with novel stimuli (ones without a history of naming) and also with individuals who have limited or no naming skills.

In MTS teaching arrangements, DORs are typically used to foster successive simple discriminations among sample stimuli, which is critical to the acquisition of conditional discriminations. However, it is quite possible that DORs may be useful in teaching other components of conditional discriminations. Skinner (1957) conceptualized a broader role for observing responses when he described their potential function in building new verbal responses (e.g., as in their role in learning to respond to questions like, ''What was on the table a moment ago?''; p. 415). Skinner's

example differs from most MTS arrangements in that the objects on the table are equivalent to the comparison stimuli in an MTS study, but they are presented and removed before the sample stimulus (i.e., the spoken question) is presented. In such cases, DORs probably foster simple discriminations among potential comparison stimuli (''noticing objects one may be asked about''; p. 415) in the environment rather than among successively presented sample stimuli (as is typical in MTS studies).

In the current investigation, we attempted to extend prior work by evaluating whether the inclusion of DORs within a prompting hierarchy would ensure that participants were attending to and discriminating the distinguishing features of the comparison stimuli in spoken-word-to-picture conditional discriminations. We did this by embedding an identity-matching task as one of the prompts within a least-to-most prompting procedure. In place of the verbal plus modeled prompt that typically follows the spoken sample stimulus in least-to-most prompting (e.g., Horner & Keilitz, 1975), we showed the participant a picture that was identical to the S+ and repeated a variation of the sample stimulus (e.g., ''this is Alex,'' while pointing to this embedded identity prompt; ''point to Alex,'' while gesturing to the comparison stimuli). Consistent selection of the correct comparison stimulus following the presentation of this embedded identity prompt would demonstrate that the participant was attending to and discriminating the relevant features of the comparison stimuli (e.g., the features that distinguish the picture of Alex from the other faces).

METHOD

Participants, Setting, and Data Collection

Jane was a 12-year-old girl who had been diagnosed with autism and who was able to follow simple instructions (e.g., sit down); she communicated by guiding people towards objects. Jane performed various simple auditory and visual discriminations during daily routines. Danny was a 10-year-old boy who had been diagnosed with autism and who communicated through gestures and followed some one-step instructions. He attended an early intervention program and learned simple auditory and visual discriminations as well as identity-matching skills via daily educational programs. In addition, attempts were made to teach Danny to attend to or scan stimuli presented during instructional demands. He rarely scanned or attended to educational materials unless physically guided to orient his head so that he made eye contact with instructional stimuli. Participants were selected because they had a history of slow or no progress in learning spoken-word-to-picture relations using least-to-most prompting, and because they were observed to frequently point to comparison stimuli without looking at them.

All sessions were conducted in a classroom in an intensive outpatient behavior center. Data collectors were positioned at a table adjacent to the child and therapist. Data were collected on unprompted and prompted correct responses. Correct responses were scored if the participant pointed to or touched the correct comparison stimulus within 5 s of the presentation of the spoken sample stimulus (i.e., ''point to Alex''). Prompted correct responses were scored if the participant pointed to or touched the correct comparison stimulus within 5 s of the modeled or identity-matching prompt (described below). Interobserver agreement for correct responses and prompted correct responses was collected during 42% of Jane's sessions and 74% of Danny's sessions and averaged 98% (range, 96% to 100%) and 99% (range, 83% to 100%), respectively.

General Procedure

For all sessions, the participant and a therapist sat at a table. All sessions included 16 trials. Each trial began with four pictures placed in front of the participant and the therapist presenting a spoken sample stimulus in the

format of "point to —." For Danny, the spoken sample stimuli were common names for household items (e.g., "cup," "soap," "chair," "book"); for Jane, they were names of unfamiliar people ("Alex," "Kim," "Mark," "Stella"). The position of the correct comparison stimulus (i.e., the S+) varied from trial to trial, and was never presented in the same position on more than two consecutive trials. Acquisition of unknown spoken-word-to-picture conditional discriminations was evaluated within a multielement experimental design.

Pretesting. To demonstrate that participants had no prior familiarity with the stimuli, 12 pictures of unfamiliar staff (Jane) or 24 pictures of unfamiliar household items (Danny) were pretested. Each sample stimulus (e.g., the spoken word "Alex") and its corresponding S+ (picture of Alex) along with three incorrect sample stimuli (S–) were presented four times during pretesting, and the order of presentation was quasirandom. Participants received no feedback for correct or incorrect responding during pretesting. Items identified correctly on less than 50% of pretest trials were included in the study. For both participants, all items included in the pretest were identified correctly on less than 50% of trials. Based on the pretest data, stimuli were randomly assigned to control, identity-matching, and least-to-most prompting conditions.

Each condition included four sample stimuli that were randomly assigned without replacement (spoken names "Alex," "Kim," "Mark," and "Stella" randomly assigned only to the identity-matching condition). For Jane, the 12 pictures corresponding to the sample stimuli (e.g., four assigned to each group times three groups) were used as the comparison stimuli. For example, if the words "Alex," "Kim," "Mark," and "Stella" were the sample stimuli in the identity-matching condition, the comparison stimuli consisted of pictures of these four people as well as the four people randomly assigned to the least-to-most condition and the four people randomly assigned to the control condition. Thus on each trial, the picture corresponding to the sample stimulus (S+) was presented along with three other stimuli randomly selected from the remaining 11. Danny's comparison stimuli consisted of the S+ and three other stimuli randomly selected from 12 pictures that did not serve as sample stimuli for any of the conditions (i.e., 12 stimuli were randomly assigned as S+ and the remaining 12 were used as S−).

Control. The control sessions were identical to the pretesting sessions. That is, the therapist presented the sample stimulus in spoken format (e.g., "point to Alex" and the picture of Alex along with three S– were placed in front of the participant). Participants received no feedback for correct or incorrect responses.

Least-to-most prompting. In this condition, four pictures were placed on a table in front of the participant as the comparison stimuli, and the therapist presented the sample stimulus in spoken format. Correct responding to the spoken sample stimulus resulted in 20-s access to a preferred item or one small food item (e.g., one M&M®). Incorrect responding to the sample stimulus resulted in a modeled prompt (e.g., "point to Alex like this," while the therapist simultaneously pointed to the correct picture). Correct responding to the modeled prompt resulted in the presentation of the next trial. Incorrect responding to the modeled prompt resulted in the therapist repeating the sample stimulus (e.g., "point to Alex") and then physically guiding the correct response.

Identity matching. This condition was identical to the least-to-most prompting condition except that the second prompt in the sequence (i.e., the modeled prompt) was replaced by an identity-matching task. That is, if the participant did not select the S+ after the initial spoken sample stimulus, the therapist held a picture that was identical to the correct comparison stimulus in front of the participant

(i.e., the S+) and said, "this is —" (while pointing to the picture the therapist was holding); "point to —" (while gesturing to the comparison stimuli). Correct responding to the identity-matching prompt resulted in presentation of the next trial, and incorrect responding resulted in the therapist repeating the sample stimulus (e.g., "point to Alex") and then physically guiding the correct response (as in least-to-most prompting).

RESULTS

Results of the control, identity-matching, and least-to-most prompting conditions are depicted in Figure 1. Jane showed at or near chance levels of correct responding in the first session of each condition. Over time, the percentage of correct responses increased in the least-to-most prompting and identity-matching conditions, but not in the control condition. For the last five sessions, the percentage of correct responses was at or close to 80% in the identity-matching condition and just over 50% in the least-to-most prompting condition. Jane's percentage of prompted correct responses was 100% for the identity-matching and least-to-most prompting conditions. That is, each time the modeled prompt was delivered in the least-to-most prompting condition and each time the identity prompt was delivered in the identity-matching condition, the prompt was followed by Jane touching the S+. Thus, physical guidance was never required in either condition.

Danny's level of correct responding was initially low in all three conditions and did not improve in either the control condition or the least-to-most prompting condition. By contrast, Danny's level of correct performance increased substantially in the identity-matching condition. Danny's percentage of prompted correct responses was 97% and 96% for the identity-matching and least-to-most prompting conditions, respectively. Thus, physical guidance was rarely required.

DISCUSSION

The identity-matching procedure appears to be a useful prompting strategy for individuals who fail to show progress with more traditional least-to-most prompting because of failure to observe the comparison stimuli. The 2 participants were specifically selected because they had not made progress in learning conditional discriminations via traditional least-to-most prompting, and because they were observed to complete many learning trials without looking at or attending to the comparison stimuli. In such cases, introducing an identity-matching task as an embedded DOR appears to be a reasonable modification to the prompting strategy. That is, the purpose of replacing the modeled prompt with an embedded identity-matching task in least-to-most prompting is to increase the probability that the individual attends to and discriminates the relevant characteristics of the S+.

Inattention and overly focused attention (overselectivity) are common problems among individuals with autism and other conditions (Aman & Langworthy, 2000; Lovaas, Koegel, & Schreibman, 1979). Dube and McIlvane (1999) showed that an embedded identity prompt can be used to decrease overselectivity (attending to one but not all relevant stimuli in a DMTS task with a compound sample stimulus). We extended their findings in the current study by showing that a similar procedure could be used for a more general form of inattention (i.e., not looking at the comparison stimuli). In addition, the performance of the participants in the Dube and McIlvane study returned to prior levels when the embedded identity prompt was withdrawn. In the current study, the identity-matching task was embedded within a prompting hierarchy and the procedure improved the participants' correct responding to the initial sample stimulus. In fact, the identity-matching task was not necessary on about 80% of trials for the last five sessions for both participants. Thus, embedding the identi-

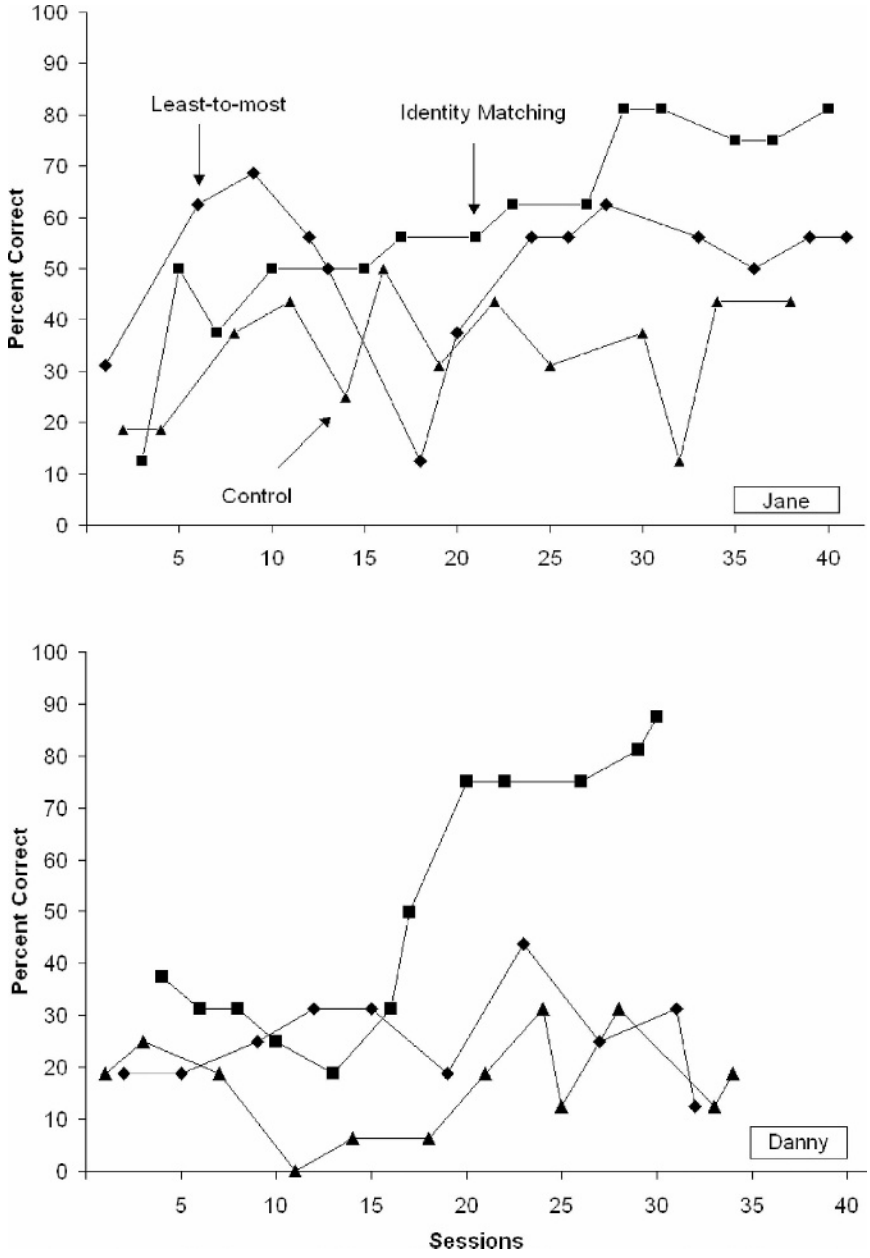

Figure 1. Percentage correct across prompting procedures for Jane and Danny.

ty-matching tasks as a DOR within a prompting hierarchy may help to facilitate the fading of the identity prompt over time. It is also noteworthy that the current identity-matching procedure was fairly simple and could be implemented by a therapist during individualized instruction, and it did not require a computer or specialized software. Future research could examine the effectiveness of the identity-matching procedure with other individuals who show signs of inattention to the comparison stimuli, or with other children who show prompt dependence because of other sources of faulty stimulus control (Green, 2001).

We hypothesize that the embedded identity-matching prompt functioned as a DOR that required the participants to attend to and discriminate the relevant characteristics of the comparison stimuli and to select the S+. Both participants selected the S+ on almost every trial after the modeled prompt in the least-to-most prompting condition and after the identity prompt in the identity-matching condition. That is, both prompts occasioned the correct response (a prompted correct response), and physical guidance was rarely required in either condition. The two conditions differed, however, in that this high level of correct responding (near 100%) could not occur in the identity-matching condition unless the participant was attending to and discriminating the visual features that differentiated the S+ from each S−. By contrast, in the least-to-most prompting condition, the participant could simply observe the position of the card that the therapist pointed to and then point to the same position; this could be done without visually examining the defining features of the S+ and each S−. Observing and imitating the motor actions of the therapist might occur because it required less effort than attending to the discriminative features of the cards (Friman & Poling, 1995) or because of a history of reinforcement for generalized imitation (Baer et al., 1967).

The current study is unique in that it used the DOR to increase attending to the comparison stimuli. In prior studies involving the use of DORs to improve MTS performances, the purpose of the DOR was to ensure that the participants looked at and discriminated the relevant characteristics of the sample stimulus (rather than the comparison stimuli). In the current study, the sample stimulus was a spoken word (spoken names of staff members or household items), and the participants spoke rarely or not at all. Thus, having them name the sample stimulus was not a viable option for a DOR.

The current study is also unique in that positive reinforcement was delivered only if the participant pointed to the S+ immediately following the initial sample stimulus. That is, positive reinforcement was withheld when the participant required either the modeled or identity prompt. This was done to prevent prompt dependence and to increase the probability that correct responding would come under the control of the sample stimulus (because the goal of training was to teach spoken-word-to-picture relations). It should be noted, however, that on the rare occasions when a participant failed to respond to the modeled or identity prompt (Danny only), the correct response was prompted using full physical guidance; thus, negative reinforcement may have motivated Danny's correct responding following the identity or modeled prompts.

The current study is limited by several factors. First, we did not conduct posttests that did not include differential reinforcement. However, this limitation is mitigated somewhat by the fact that the identity-matching condition produced substantially better performance than the control condition, which did not include differential reinforcement, and the least-to-most prompting condition, which did.

A second limitation is that we did not use a balanced design in which each picture was presented as an S+ or an S− an equal number of times (e.g., if there were four pictures in the pool of stimuli and four pictures presented per trial, each picture would be presented as an S+ on one quarter of the trials and as an S− on three quarters of the trials in a balanced design). Such a design would definitively demonstrate that the participants were responding conditionally to the spoken sample stimuli (e.g., touching the picture of the Alex when the word "Alex" was spoken and refraining from touching the picture of Alex when one of the other words was spoken). With Jane, each picture was presented an equal number of times as an S+ and approximately an equal number of times as an S−. However, each picture was exclusively presented as an S+ in one condition (e.g., four of the 12 pictures served as S+ in the identity-

matching condition, four in the least-to-most condition, and four in the control condition), but all 12 pictures were used as an S− in each of the three conditions. Thus, responding in any one condition could have been affected by Jane's acquisition of conditional discriminations in another condition (i.e., multiple-treatment interference; e.g., if she learned that the picture of Alex was the S+ when the name "Alex" was spoken in one condition, she could rule out that stimulus when it was an S− in the other conditions). However, if this had occurred, then the differences between the identity-matching and the other two conditions were underestimated rather than overestimated (i.e., the learning of conditional discriminations in the identity-matching condition may have increased the level of correct responding in the other two conditions). Thus, for Jane, a balanced design might have shown even greater differences between the identity-matching condition and the other two conditions. Despite this limitation, the results clearly show that Jane was responding conditionally to the spoken sample stimuli (e.g., selecting the picture of Alex when "Alex" was the spoken sample stimulus and refraining from selecting "Alex" when the picture of Alex was presented as an S−). That is, pictures corresponding to sample stimuli from the identity-matching condition were presented as S− in the identity-matching condition on approximately 61% of the trials, and she could not have obtained 80% accuracy if she was simply selecting pictures that had previously produced reinforcement in this condition (i.e., if she was displaying simple rather than conditional discriminations).

The fact that a balanced design was not used with Danny is potentially more troublesome relative to the question of whether conditional discriminations were truly established. For Danny, a pool of the same 12 untrained stimuli was presented as S− during each condition (i.e., stimuli that were never presented as S+). Although previous research indicates that using untrained stimuli as S− may result in responding away from these stimuli (Green, 2001; Johnson & Sidman, 1993), this was not the case in the present study. Responding away from untrained stimuli would have resulted in highly accurate performance across conditions, as opposed to differentially high levels of accuracy in the identity-matching condition. Nevertheless, the fact that each S+ used in each condition was never presented as an S− in any of the comparison arrays leaves open the possibility that he learned simple rather than conditional discriminations. That is, it is possible that Danny learned to discriminate each S+ from the other comparison stimuli in the array independent of the spoken sample stimulus (because each picture that served as an S+ never served as an S−, and as a result, was always correlated with reinforcement). Therefore, we did not demonstrate that Danny both selected a given stimulus (e.g., picture of a fork) when the corresponding word was spoken (e.g., "fork") and also refrained from selecting this picture when a different word was the sample stimulus (e.g., "cup"). Nevertheless, the purpose of the identity prompt was to foster discriminations among the comparison stimuli, and that clearly occurred in the identity-matching condition, even if he learned simple rather than conditional discriminations.

In summary, observing responses are critical to the development of stimulus control (Dinsmoor, 1985), and DORs allow the behavior analyst to confirm that the individual is not only looking at but also is discriminating the relevant features of the discriminative stimuli. DORs may be used to foster simple discriminations among successive sample stimuli or, as in the current investigation, among concurrently presented comparison stimuli, both of which are essential to the development of conditional discriminations. Future investigations should replicate these findings using a larger number of participants and a balanced design. In addition, the identity-matching procedure should be

compared with other prompting strategies, such as prompt delay (e.g., Charlop et al., 1985; Clark & Green, 2004; Halle et al., 1979).

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